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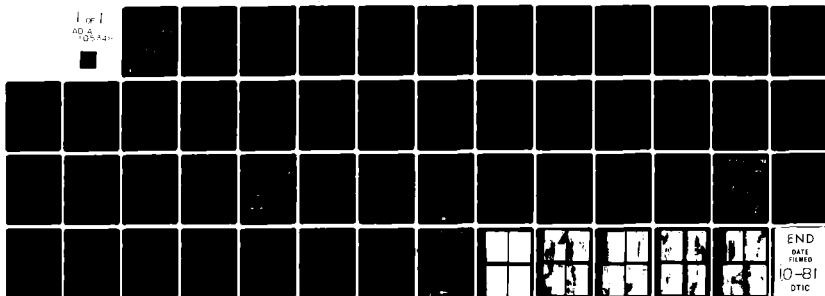
ANDERSON ENGINEERING INC SPRINGFIELD MO
NATIONAL DAM SAFETY PROGRAM. G. GUNDAKER DAM (MO 30543), MISSIS--ETC(U)
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**G. GUNDAKER DAM
FRANKLIN COUNTY, MISSOURI
MO 30543**

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PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY INSPECTION



**United States Army
Corps of Engineers**
... Serving the Army
... Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: G. Gundaker Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the G. Gundaker Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- 1) Spillway will not pass 50 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure
- 3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY:

Chief, Engineering Division

SIGNED

31 AUG 1979

Date _____

APPROVED BY:

Colonel, CE, District Engineer

SIGNED

31 AUG 1973

Date

[illegible]

G. GUNDAKER DAM
FRANKLIN COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30543

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By
Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of
St. Louis District, Corps of Engineers

For
Governor of Missouri

August 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	G. Gundaker Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Tributary to Brush Creek
Date of Inspection:	May 9, 1979

The G. Gundaker Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers.

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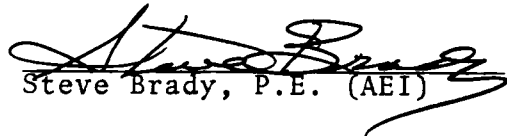
The estimated damage zone extends approximately two miles downstream. Within that damage zone is a large public park, The Missouri Botanical Garden Arboretum.

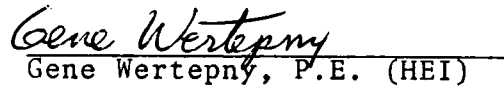
Four miles downstream of the dam. A railroad, a mobile home park and five dwellings are located within this zone.

Our inspection and evaluation indicates that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 22 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering that the maximum storage capacity is only 92 acre-ft and that the height of the dam is only 27.7 ft, 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year frequency flood will not overtop the dam. The 100-year flood is one that has a 1 percent chance of being exceeded in any given year.

Deficiencies visually observed by the inspection team were: (1) wet areas (apparent seepage) at the west abutment-dam contact; (2) sloughing of the upstream face; (3) trees on the dam; (4) animal burrows; (5) clogged fish screen on the primary spillway weir; (6) and brush in the primary spillway downstream of the concrete control weir. Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.


Steve Brady, P.E. (AEI)


Gene Wertepny, P.E. (HEI)


Tom Beckley, P.E. (AEI)


Dave Daniels, P.E. (HEI)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
G. GUNDAKER DAM - ID No. 30543

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of G. Gundaker Dam in Franklin County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT:

A. Description of Dam and Appurtenances:

G. Gundaker Dam is an earth fill structure approximately 27.7 ft high and 970 ft long at the crest. The appurtenant works consist of rock cut primary spillway with concrete control section in the west abutment, an earth swale emergency spillway in the east abutment and a drain-down pipe with valve at the downstream end. Sheet 3 of Appendix A shows a plan profile and typical section of the embankment.

B. Location:

The dam is located in the northeast part of Franklin County, Missouri on a tributary of Brush Creek. The dam and lake are within the Gray Summit, Missouri 7.5 minute quadrangle sheet (Section 18, T43N, R2E - latitude $38^{\circ} 28.3'$; longitude $90^{\circ} 49.9'$). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 27.7 ft and a maximum storage capacity of approximately 92 acre-ft, the dam is in the small size category.

D. Hazard Classification:

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The estimated damage zone extends approximately two miles downstream. Within that damage zone is a large public park, The Missouri Botanical Garden Arboretum.

E. Ownership:

The dam is owned by Gordon Gundaker Real Estate. The owner's address is 940 West Port Plaza, Suite 102, Creve Coeur, Missouri 63141.

F. Purpose of Dam:

The dam was constructed primarily for recreational purposes.

G. Design and Construction History:

No design information or plans are available. Ruth Hall, private secretary to Mr. Sidney Solomon, indicated that the property was originally owned by a Mr. Jonathan Kludt, and that a small dam and lake existed on the site when Mr. Solomon purchased the property in about 1966. Mr. G. H. Williams of St. Clair, Missouri indicated that the original dam was about 15 ft in height and less than half of its present length. He indicated that the lake was only 1 or 2 acres in surface area. Mr. Williams indicated that he

enlarged the dam and cut in the primary spillway in about 1966. He indicated that the dam was lengthened in both the west and east directions to its present size, and that an emergency spillway swale was constructed on the east end.

At some later date, a small dam was constructed below the main dam. The existence of an apparent aeration system in the now dry lake bed indicates that this small pond below the main dam may have been used for fish rearing. According to the present caretaker of the property, the concrete overflow for the lower dam washed out, and the lower dam was breached several years ago.

In 1974, Fruin Colnon of St. Louis installed a temporary siphon system to draw down the lake. In April and May 1975, a draindown pipe was installed under the dam by Robert Affholder, Inc. Mr. Affholder indicated that with the lake drawn down, a 130 ft long 18 in. diameter casing was bored under the dam at a location west of the center of the dam, starting at a point about 30 ft downstream of the toe. An upward elbow with a trash screen was attached at the upstream end. An upstream valve was envisioned at this time, but it is doubtful that it was ever installed. On the downstream side, the pipe is approximately 3 ft below the original ground surface. A reduction was made to an 8 in. pipe, and a bend was incorporated toward the present outlet where a valve was attached (see photo No. 20).

During the summer of 1975, the lake area was dredged, and the dredged materials were used to construct a small island in the middle of the lake as shown in photos 1, 2, 3, and 14. The property is now owned by Gundaker Real Estate.

H. Normal Operating Procedures:

Normal flows are passed by an uncontrolled overflow spillway, whereas an earth emergency spillway comes into operation for major floods. The caretaker has indicated that the highest water in recent memory occurred in April 1979 when water went over the emergency spillway.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 358 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through uncontrolled spillways.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - Low Point El. 101.4): 1154 cfs
- (3) Estimated Capacity of Primary Spillway: 834 cfs
- (4) Estimated Experienced Maximum Flood at Dam Site: 800 cfs (Elev. 101)
- (5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable
- (6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (7) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed elevation of 100.0 for the top of the concrete wing wall at the east end of the spillway.

- (1) Top of Dam: 101.4 (Low Point); 102.4 (High Point)
- (2) Principal Spillway Crest: 97.7 (low point - see Sheet 3, Appendix A)
- (3) Emergency Spillway Crest: 100.5
- (4) Principal Outlet Pipe Invert: None

- (5) Streambed at Centerline of Dam: 74.7
- (6) Pool on Date of Inspection: 98.8
- (7) Apparent High Water Mark: 101
- (8) Maximum Tailwater: Unknown
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Top of Dam: 1100 ft
- (2) At Principal Spillway Crest: 1000 ft
- (3) At Emergency Spillway Crest: 1050 ft

E. Storage Capacities:

- (1) At Principal Spillway Crest: 61 ac-ft
- (2) At Top of Dam: 92 ac-ft (Elev. 101.4)
- (3) At Emergency Spillway Crest: 84 ac-ft

F. Reservoir Surface Areas:

- (1) At Principal Spillway Crest: 8 acres
- (2) At Top of Dam: 9 acres (Elev. 101.4)
- (3) At Emergency Spillway Crest: 8.6 acres

G. Dam:

- (1) Type: Earth
- (2) Length at Crest: 970 ft

- (3) Height: 27.7 ft
- (4) Top Width: 12 ft
- (5) Side Slopes: Upstream 3.9H:1V; Downstream 3.5H:1V (Avg.)
- (6) Zoning: None (Homogeneous)
- (7) Impervious Core: None
- (8) Cutoff: Unknown
- (9) Grout Curtain: None

H. Diversion and Regulating Tunnel:

- (1) Type: None
- (2) Length: Not Applicable
- (3) Closure: Not Applicable
- (4) Access: Not Applicable
- (5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location: West Abutment
- (2) Type: Rock cut with concrete control section

I.2 Emergency Spillway:

- (1) Location: East abutment
- (2) Type: Earth Swale in East Abutment (Partially Paved Crest)

J. Regulating Outlets:

An 8 in. diameter steel pipe is located as shown on sheet 4 of Appendix A for draindown purposes. The valve for the pipe is located at the downstream end of the dam (see photo No. 20). Section 1.2G discusses the draindown facilities in more detail.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No engineering data exist for this dam. To our knowledge, no construction inspection records or documented maintenance and operation data exist.

A. Surveys:

To our knowledge, no detailed surveys have been made of the dam. The top of the concrete wing wall at the east end of the spillway was used as datum for our site survey (Elev. 100). It is estimated that this site datum corresponds to a mean sea level elevation of about 600.

B. Geology and Subsurface Materials:

The site is located at the northeastern edge of the Ozarks. The Ozarks are characterized topographically by hills, plateaus and deep valleys. The most common rock types are dolomite, sandstone and chert. Information from the Missouri Geological Survey indicates that sites investigated within the area indicate that there is 7 ft to 15 ft of modified loess over Jefferson City Dolomite. The Jefferson City dolomite in this area has low fracture permeability except on steep weathered slopes. Bedrock surfaces have an evenly weathered surface. The "Geologic Map of Missouri" indicates that the nearest known faults are 5 or 6 miles southwest of the site. The Department of Natural Resources has indicated that the faults in the area are generally considered to be inactive and have been for several hundred million years. The publication "Caves of Missouri" indicates that most of the known caves in Franklin County are in the south-central portion (15 to 20 miles from the site).

Soils in the area are of the Menfro-Winfield-Weldon association and have developed from loessial deposits over residual materials. Inspection of the spillway banks indicated 3 ft or 4 ft of modified loess (brown silty clay to clayey silt) over 2 ft or 3 ft of residuum (red-brn silty clay with rock fragments).

C. Foundation and Embankment Design:

It is believed that the material for the dam was taken from the lake area and probably consists of both silty clay residuum and modified loess. Shallow auger probes into the dam indicated a brown and gray silty clay to clayey silt. The original dam was approximately 15 ft high and less than half of the length of the present dam. The enlargement is reported to have been built with a clay key but no internal drainage features. The dam has been riprapped on the upstream face to a level approximately 2 ft below the crest. The lower limit of the riprap is not known. No design computations or construction inspection records were available.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design data were obtained. Our analyses of the PMF are presented in Appendix C. These analyses were based on our field survey and observations, and estimates of areas and volumes from the U.S.G.S. quad sheet. It was concluded that the structure will pass 22 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will not overtop the dam.

E. Structure:

The only appurtenant structures are the draindown pipe and the concrete control section for the primary spillway. The control section appeared to be in good condition. It is not known whether the draindown pipe has ever been used.

2.2 CONSTRUCTION:

No construction inspection data were available.

2.3 OPERATION AND MAINTENANCE:

To our knowledge, there are no operating records. The caretaker indicated that the grass on the dam is cut regularly. Three wells in the east abutment area are used to supply water to the lake during low-flow periods.

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

C. Validity:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on May 9, 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulics Engineer)
Dave Daniels - Hanson Engineers, Inc. (Geotechnical Engineer)

B. Dam:

The dam appears to be generally in good condition. No obvious seepage through the embankment was noted. The dam has been constructed on a slight curve which is concave to the downstream direction. The dam is fairly level across the crest, and no surface cracking or unusual movement was obvious. Shallow auger probes into the embankment indicated the embankment to consist of a brown and gray silty clay to clayey silt.

There is an apparent area of seepage under the dam at the downstream contact on the west abutment side (see sheet 4 of Appendix A and photos 9, 10 and 11). The apparent seepage is manifested by wet, soft ground, cattails and small pools of rust-colored water. There is also a 30 ft diameter stagnant pool of water near the downstream toe at about the center of the dam. This appears to be near the area described as the starting point of the bored draindown pipe and could represent a depressed area due to sunken backfill or possible seepage under the dam along the pipe. The middle of the floodplain downstream (old pond area - probable location of original streambed) was wet and soft. A noticeable but small stream of water was flowing out of this area through the breach in the old dam below the main dam (see photos 12 and 13). To our knowledge, there had been no rain in recent days. The caretaker indicated there had been a 5 in. rain about three weeks before our site inspection.

Several small trees were on the downstream face near the toe. There were also several small trees and a few fairly large trees on the upstream face within a few feet of the crest of the dam. Several small animal holes were also noted on the downstream face .

The upstream face of the embankment above the riprap is sloughing due to wave erosion all along the dam. The sloughing is particularly noticeable around some fairly large trees which are located all along the upstream face 1 or 2 ft below the crest.

No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The approach to the spillway is fairly clear, and the embankment side is riprapped. The concrete control section is in good condition. The outlet area just beyond the weir has some brush and small trees. Pool levels appear to be controlled somewhat by a clogged fish screen. On the day of inspection, the water level was about 1.1 ft above the low point in the control section.

C.2. Emergency Spillway:

The emergency spillway is a grass covered earth swale in the east abutment. The crest is partially paved with bituminous concrete. The emergency spillway was apparently used in April 1979. No apparent damage was observed.

D. Reservoir:

The slopes adjacent to the watershed are moderate, and no sloughing or serious erosion was noted. The watershed is primarily grassy areas with some timber.

E. Downstream Channel:

The spillway beyond the control section is shelved in bedrock and fairly clear all the way down to the stream channel. The spillway is well away from the dam, and releases would not be expected to endanger its integrity.

3.2 EVALUATION:

The apparent seepage areas should be investigated by an engineer experienced in the design and construction of dams. Remedial measures may be required. As a minimum, these areas should be inspected periodically in an effort to detect an increase in the quantity of seepage or any indication that soil particles are being carried by the water. In this event, an engineer experienced in the design and construction of dams should be contacted immediately.

The erosional damage of the upstream slope should be corrected and then maintained. Erosion protection for the top of the dam may be advisable. Animal holes should be repaired on the downstream face. Trees and brush are not desirable on an earth dam. The possibility exists that a large tree could be uprooted by wind forces during a heavy storm and initiate overtopping and erosional failure at that point. Also, root systems may provide a channel for piping action which could endanger the stability of the dam.

The primary spillway outlet area should be cleared of vegetation. It would appear advisable to remove the fish screen. The higher lake level caused by the clogged fish screen results in less storage capacity available for larger storms, and the emergency spillway would have to come into service more often.

Because the valve of the lake drain is located on the downstream side of the dam, the full head of water impounded by the dam is acting entirely through the dam. The area around the lake drain outlet should be periodically inspected for seepage which might indicate a leak or rupture of the drainpipe which could initiate a piping failure through the embankment.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam except for the drawdown pipe. The spillways are uncontrolled, so that the pool is normally controlled by rainfall, runoff and evaporation.

4.2 MAINTENANCE OF DAM:

The caretaker indicated that the grass is cut periodically.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Although the draindown facilities appear to be in good condition, it is not known whether they are regularly maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

Trees and brush should be cut annually. Animal holes should be filled, and erosional areas should be maintained. The spillway outlet should be periodically cleared of vegetation. The dam should be periodically inspected to detect possible seepage under or through the embankment, especially in the apparent seepage areas noted in this report and in the area of the drawdown pipe.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field survey of spillway dimensions and embankment elevations; and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet. No previous hydraulic or hydrologic studies were obtained. Our hydrologic and hydraulic analyses using U. S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approach to the primary spillway is fairly clear, and the embankment side is riprapped. The concrete control section is in good condition. The outlet area just beyond the weir has some brush and small trees. The spillway beyond this area is shelved in bedrock and fairly clear all the way down to the stream channel. The spillway is well away from the dam, and releases would not be expected to endanger its integrity. Pool levels appear to be controlled somewhat by a clogged fish screen. On the day of inspection, the water level was about 1.1 ft above the low point in the control section.

The emergency spillway is a grass covered earth swale in the east abutment. The crest is partially paved with bituminous concrete. The emergency spillway was apparently used in April 1979. No apparent damage was observed.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 22 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering that the maximum storage capacity is only 92 acre-ft and that the height of the dam is only 27.7 ft, 50 percent of the PMF has been determined

to be the appropriate spillway design flood. The structure will pass a 100-year frequency flood without overtopping. It should be noted that if the top of the fish screen were used as normal pool (beginning point of the routing), then the structure would probably not pass the 100-year frequency flood without overtopping.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 0.89 ft at elevation 102.29. The duration of the overtopping will be .67 hours, and the maximum outflow will be 2979 cfs. The maximum discharge capacity of the spillways is 1154 cfs. The soils encountered in the dam are silty and would be fairly erodible.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Visual observations which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

It is believed that the material for the dam was taken from the lake area and probably consists of both silty clay residuum and modified loess. Shallow auger probes into the dam indicated a brown and gray silty clay to clayey silt. The original dam was approximately 15 ft high and less than half of the length of the present dam. The enlargement is reported to have been built with a clay key but no internal drainage features. The dam has been riprapped on the upstream face to a level approximately 2 ft below the crest. The lower limit of the riprap is not known. No design and construction data were found. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

No operating records have been obtained.

D. Post-Construction Changes:

Significant post construction changes have been made and are outlined in Section 1.2G.

E. Seismic Stability:

The structure is located in seismic zone 2 near the boundary of zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) wet areas (apparent seepage) at the west abutment-dam contact; (2) sloughing of the upstream face; (3) trees on the dam; (4) animal burrows; (5) clogged fish screen on the primary spillway weir; (6) brush in the primary spillway downstream of the concrete control weir.

The dam will be overtopped by flows in excess of 22 percent of the Probable Maximum Flood. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future. Priority should be given to increasing the size of the spillway and investigation and continued observation of the apparent seepage.

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 2 near the boundary between zones 1 and 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

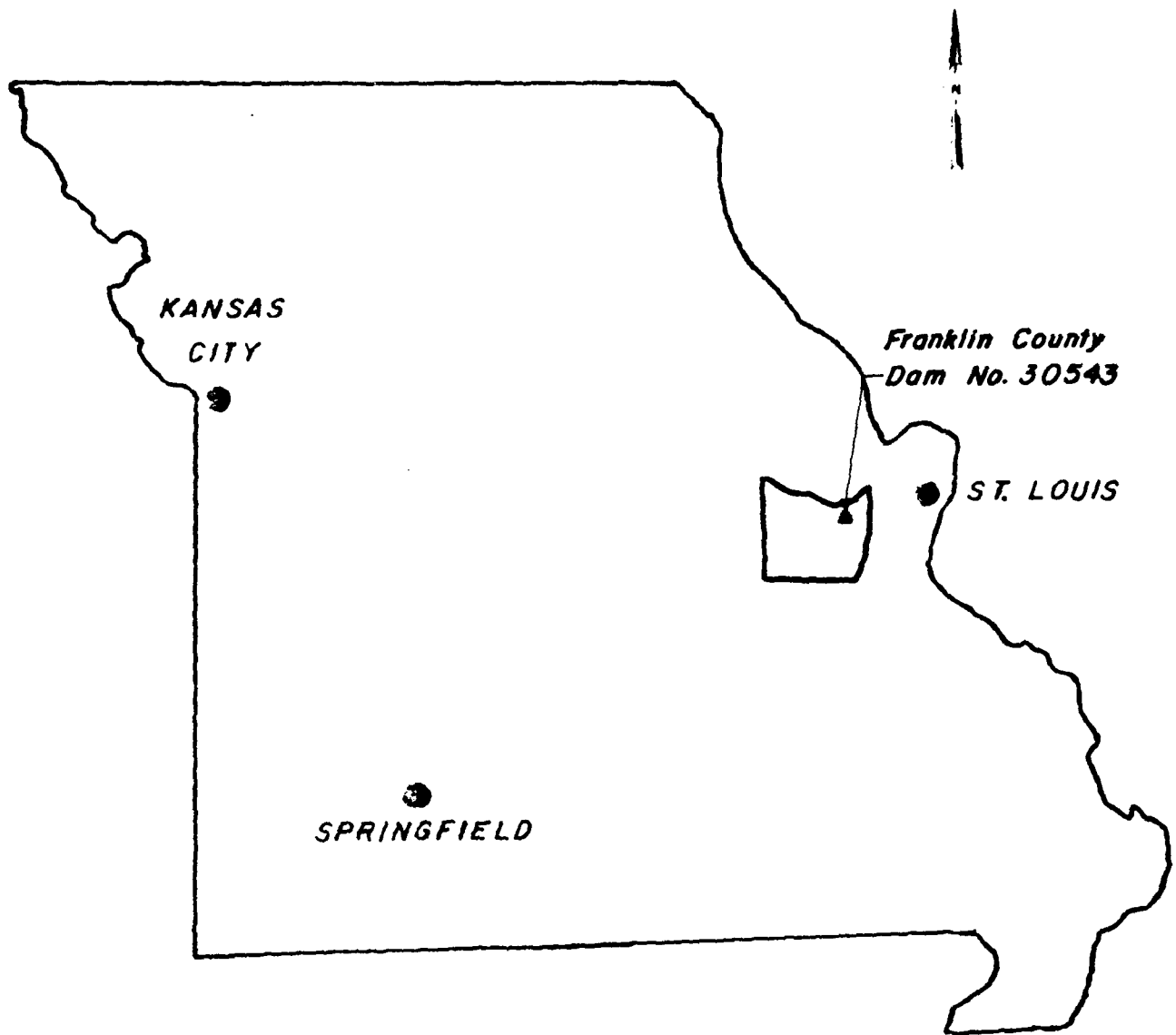
7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

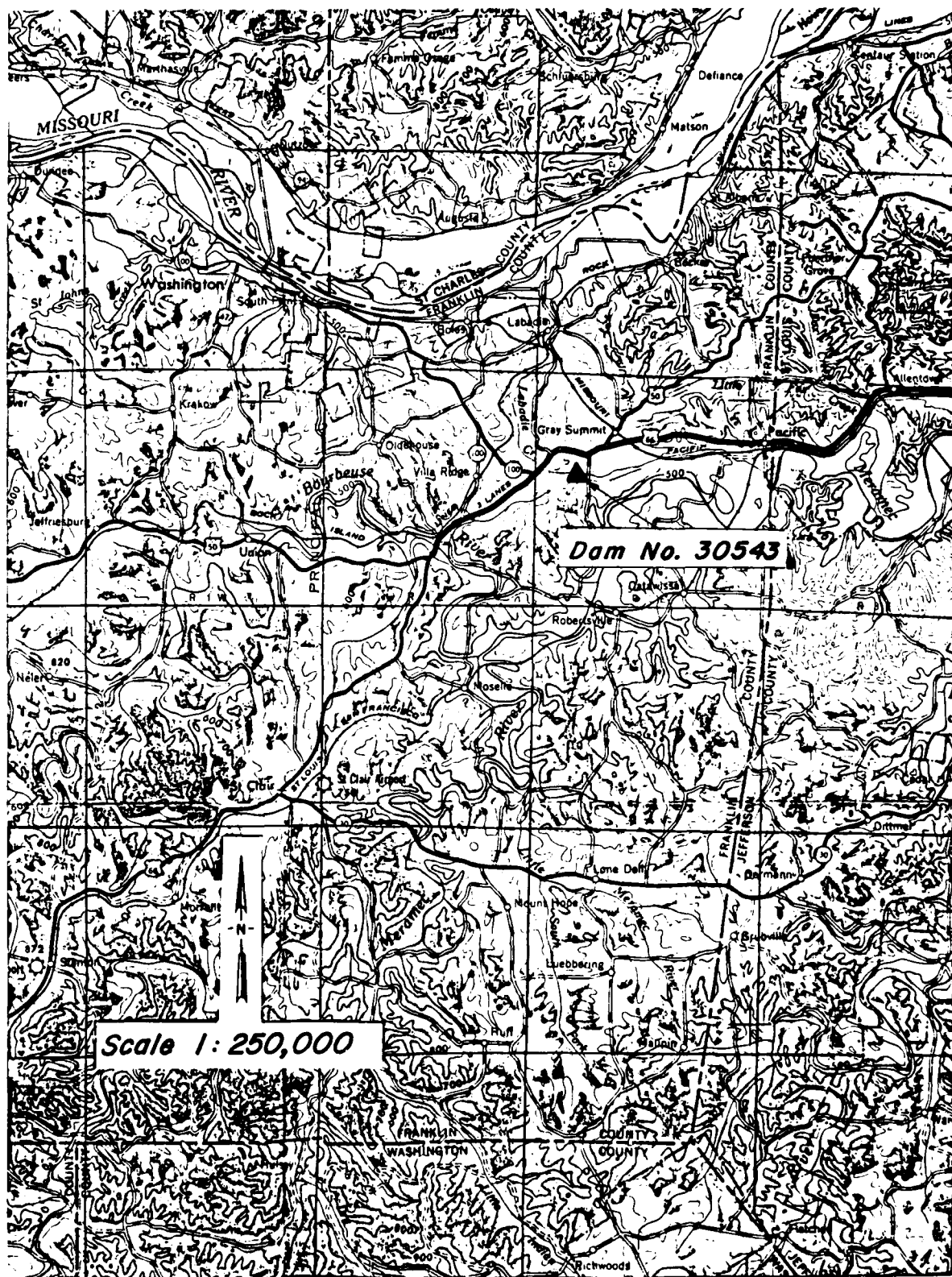
- (1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.
- (2) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (3) The apparent seepage areas should be investigated by an engineer experienced in the design and construction of dams. Remedial measures may be required. As a minimum, these areas should be inspected periodically in an effort to detect an increase in the quantity of seepage or any indication that soil particles are being carried by the water. In this event, an engineer experienced in the design and construction of dams should be contacted immediately. The area around the exit of the draindown pipe should be inspected to determine whether seepage is occurring along the pipe. Remedial measures may be required.
- (4) The erosional damage of the upstream slope should be corrected and then maintained. Erosion protection to the top of the dam may be advisable.

- (5) Animal holes should be repaired.
- (6) Trees and brush should be removed. Trees and brush are not desirable on an earth dam. The possibility exists that a large tree could be uprooted by wind forces during a heavy storm and initiate overtopping and erosional failure at that point. Also, root systems may provide a channel for piping action which could endanger the stability of the dam. Trees should be removed under the direction of an engineer experienced in the design of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.
- (7) The primary spillway outlet area should be cleared of vegetation. It would appear advisable to remove the fish screen. The higher lake level caused by the clogged fish screen leaves less storage capacity available for larger storms, and the emergency spillway would have to come into service more often.
- (8) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

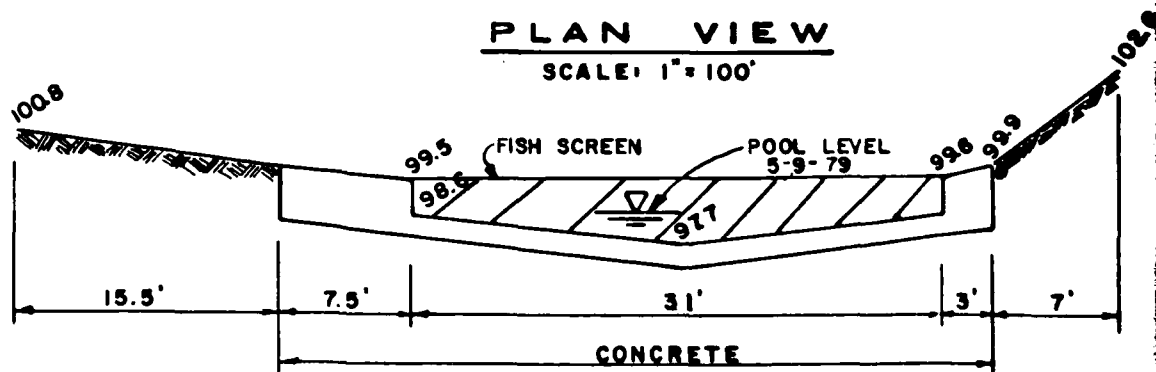
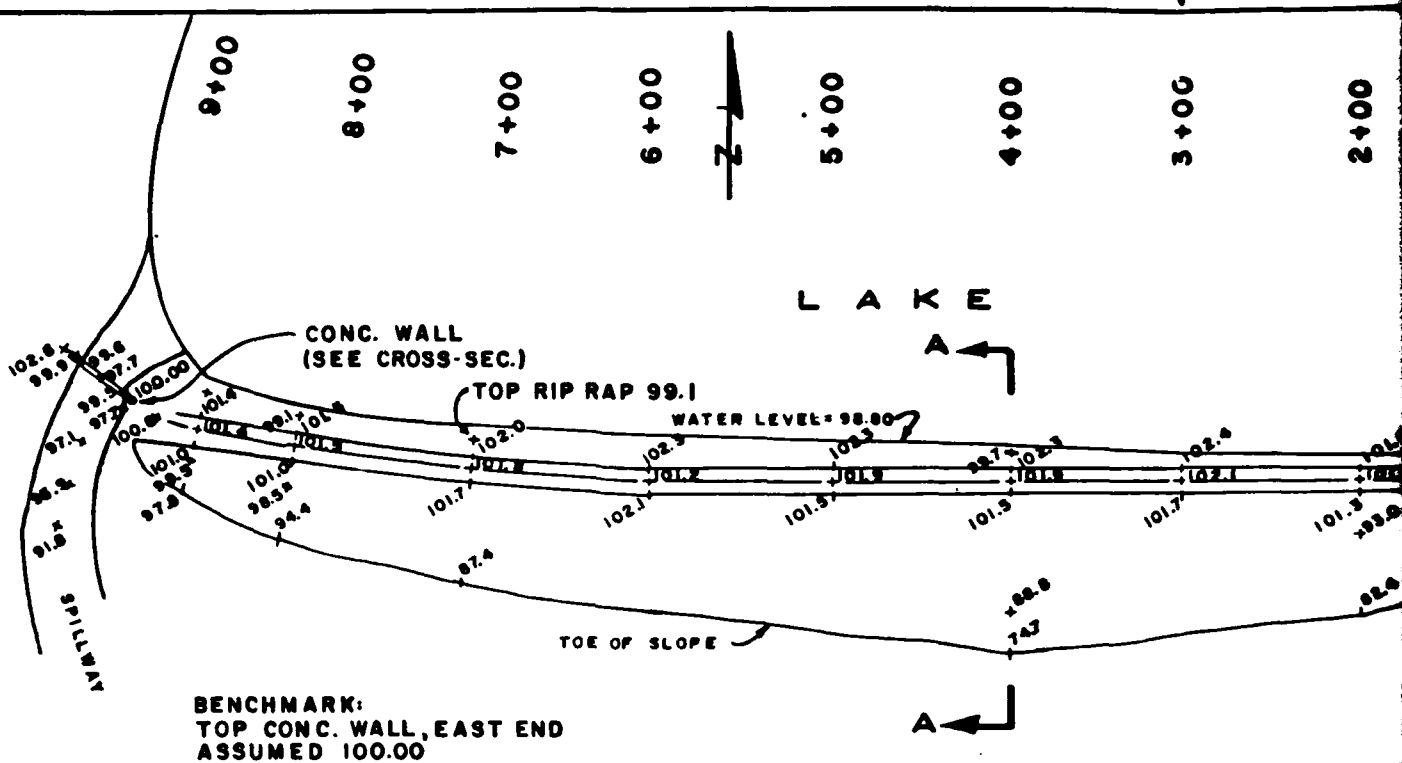


LOCATION MAP

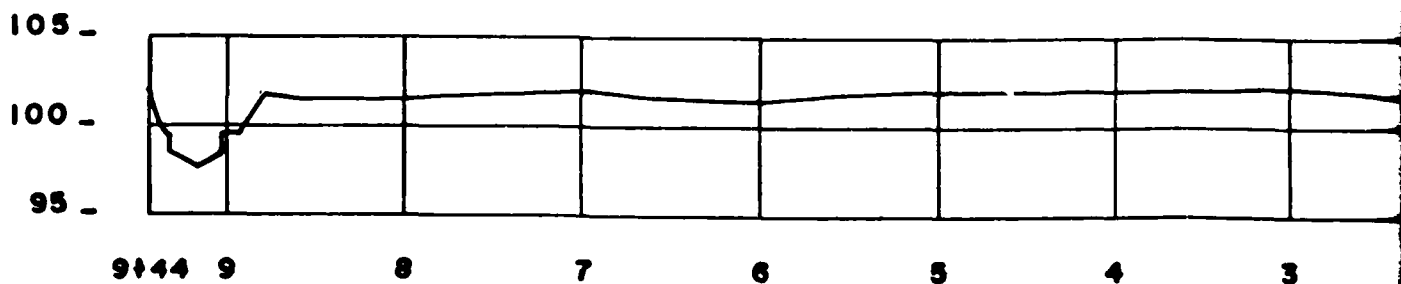


Scale 1: 250,000

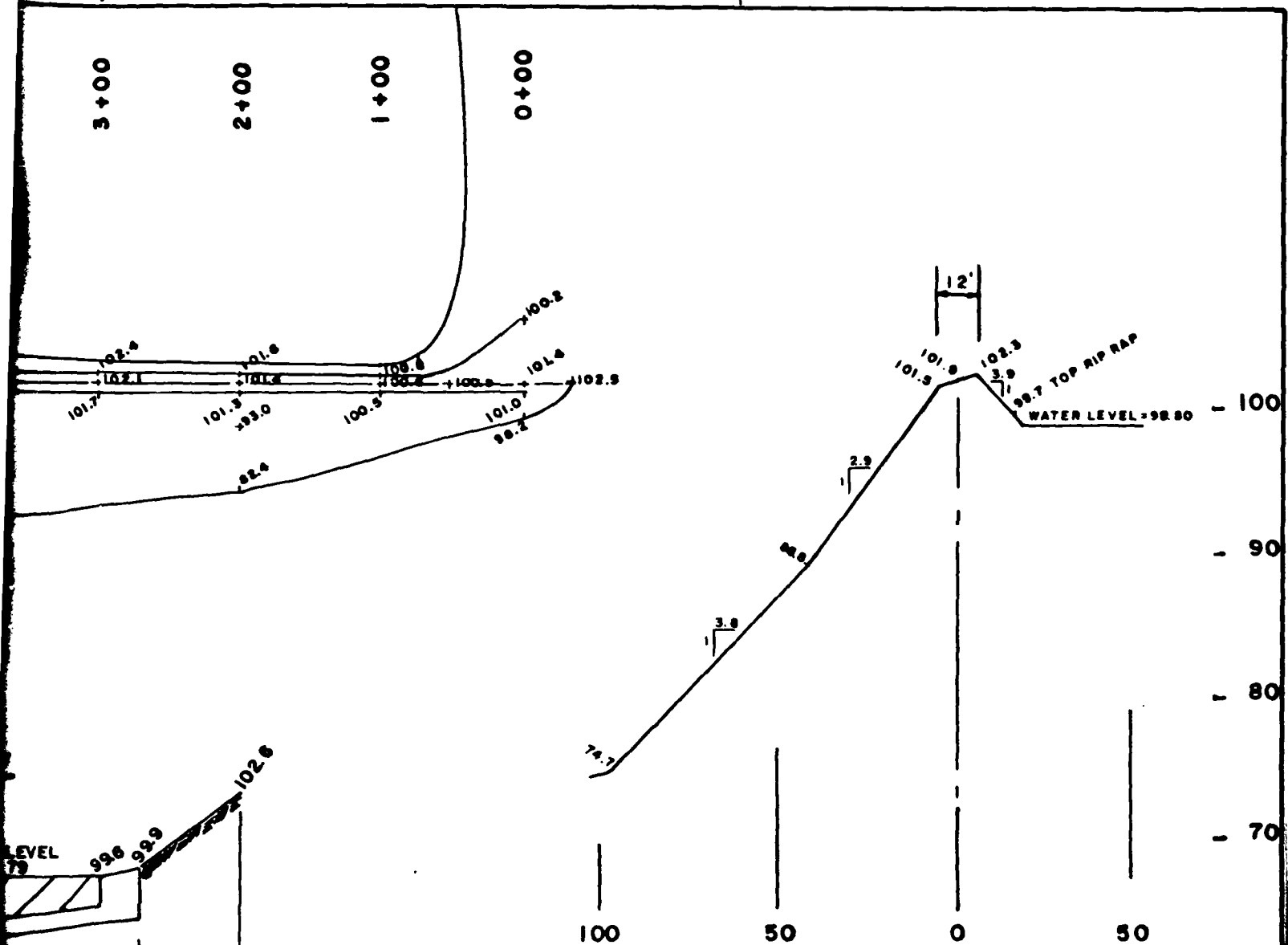
SITE VICINITY MAP



SPILLWAY CROSS-SECTION
NOT TO SCALE

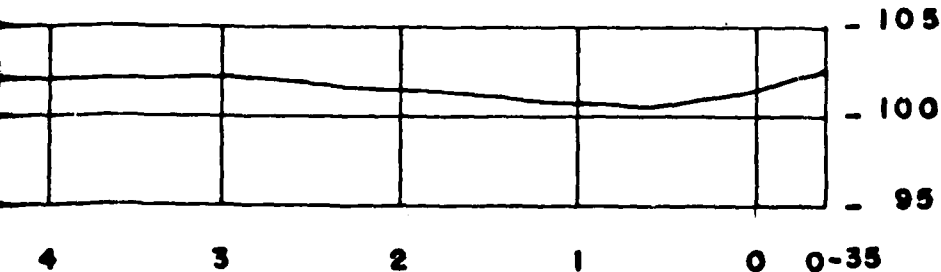


PROFILE



SECTION A-A STA 4+00

SECTION



PROFILE

Sheet 3 Appendix A

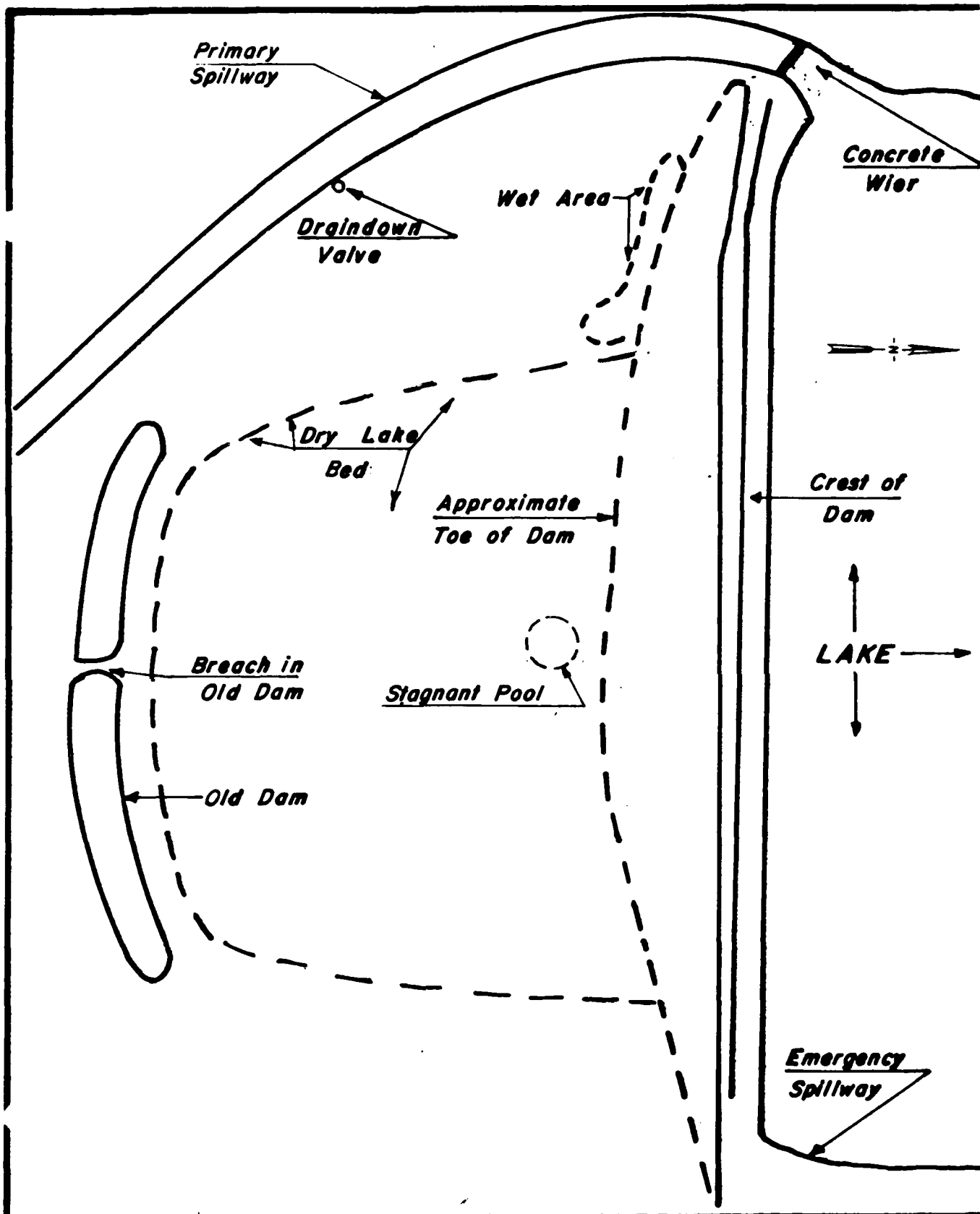
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

MO. No. 30543

PLAN & PROFILE

FRANKLIN COUNTY, MO.

2



DRAWN DER
 CHECKED DED
 DATE 6-18-79
 NO. 70411



SPRINGFIELD ILL.

PEORIA ILL.

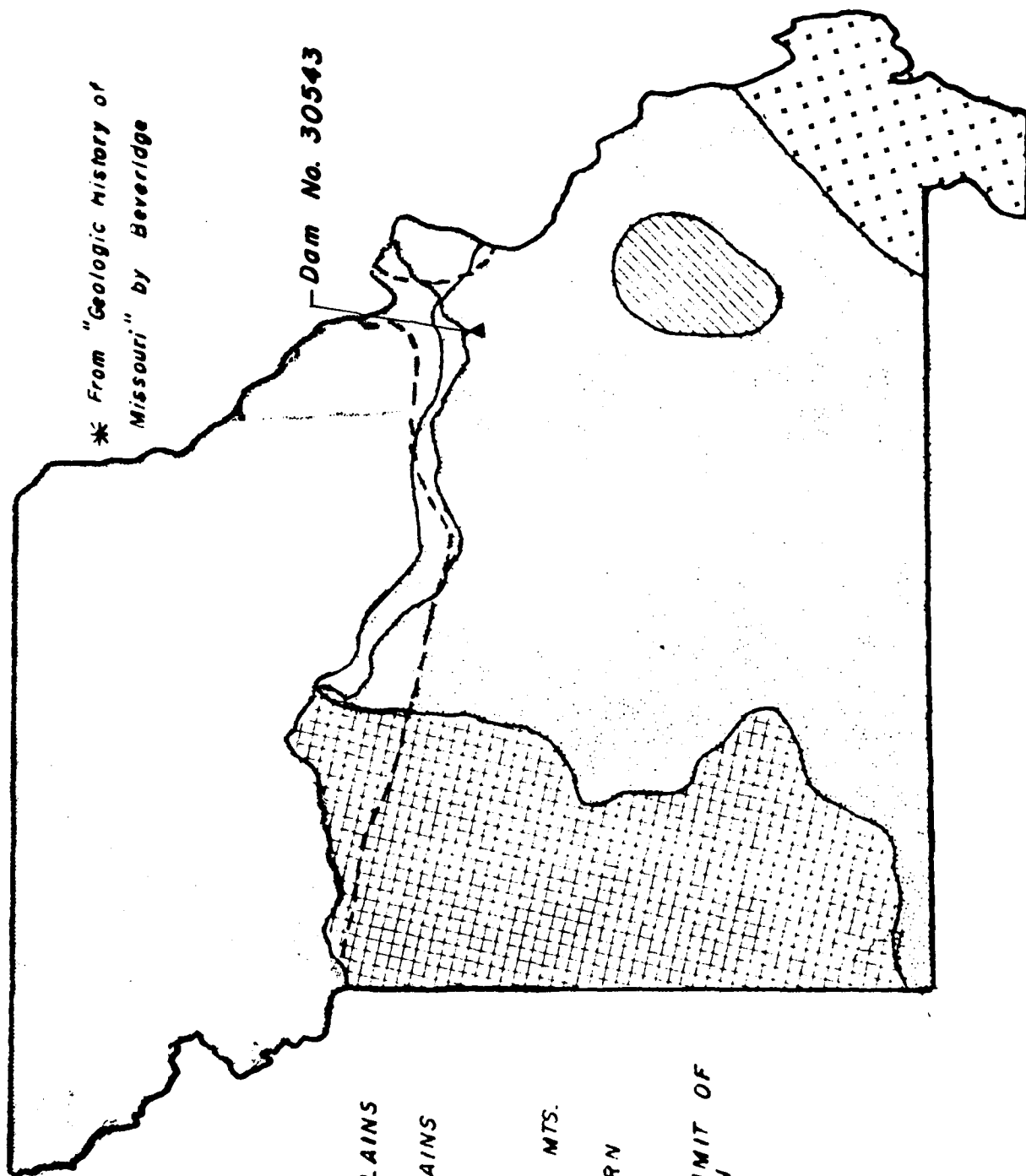
Plan Sketch
Inspection Observations
Sheet 4 Appendix A

APPENDIX B

MAJOR GEOLOGIC REGIONS OF MISSOURI

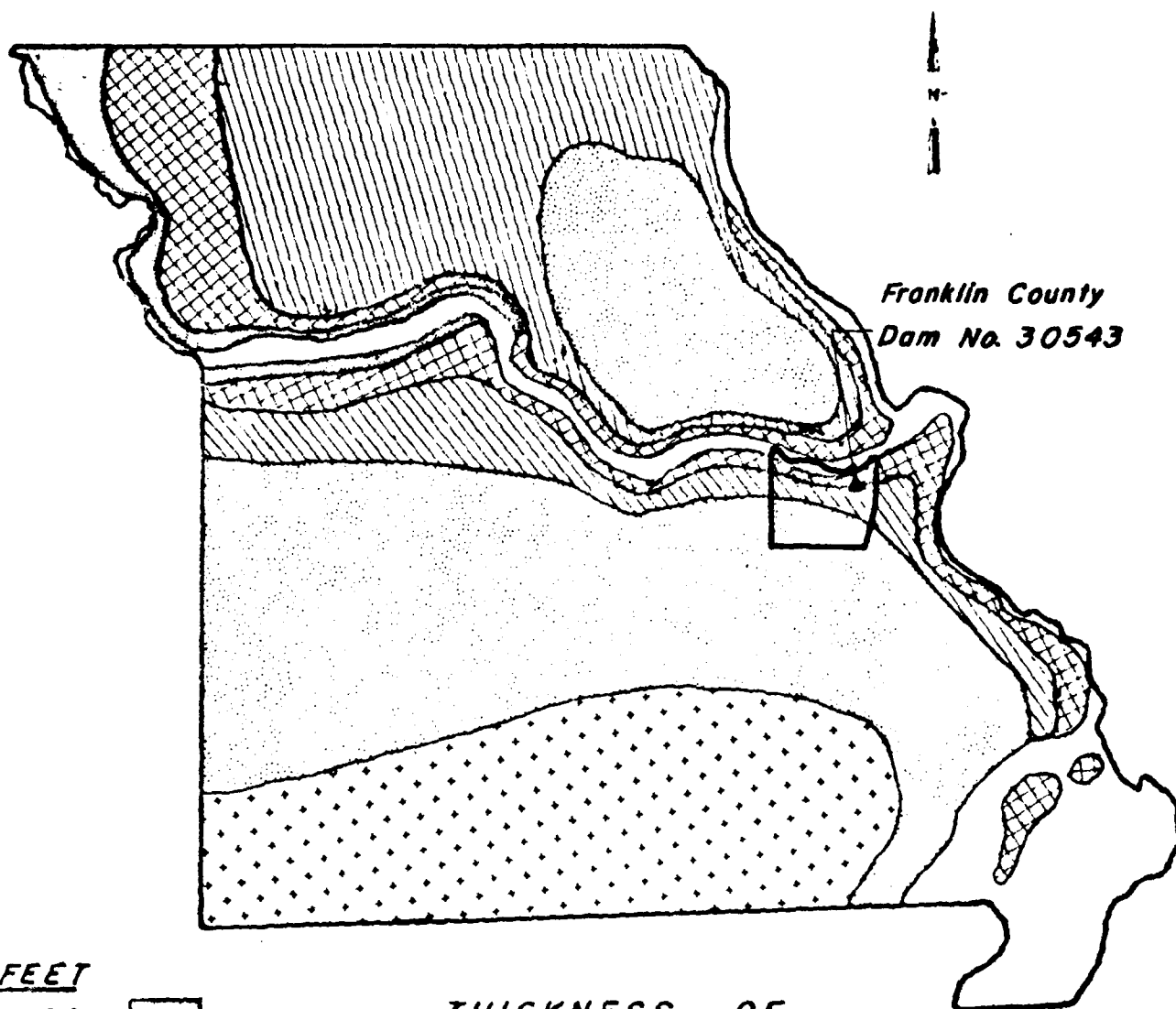
* From "Geologic History of Missouri" by Beveridge

Dam No. 30543



- GLACIATED PLAINS
- WESTERN PLAINS
- OZARKS
- ST. FRANCOIS MTS.
- SOUTHEASTERN LOWLANDS
- SOUTHERN LIMIT OF GLACIATION

* From "Soils of Missouri"



<u>FEET</u>	
20+	
10-20	
5-10	
2.5-5	
2.5-	

THICKNESS OF
LOESSIAL DEPOSITS

SHEET 2 OF APPENDIX B

APPENDIX C



LAKE AND WATERSHED MAP

Sheet 1 Appendix C

HYDRAULIC AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. The caretaker of the property indicated that the dam has never been overtopped but that the emergency spillway operated in April, 1979 for the first time in over 5 years.

Visual Inspection: At the time of the inspection the pool level (El. 98.8) was approximately 1.1 ft above normal pool (El. 97.7). It should be noted that a clogged fish screen attached to the concrete control section apparently raises the pool level of the lake. In our analysis, the low point of the concrete control section was used as normal pool (El. 97.7). It would appear advisable to remove the fish screen, since it could raise the lake level between 1 ft and 2 ft and thus reduce the discharge capacity of the structure significantly.

Overtopping Potential: Flood routings were performed to determine the overtopping potential. The watershed and the reservoir surface areas were obtained by planimeter from the U.S.G.S. Gray Summit, Missouri 7.5 minute quadrangle map. The storage volume was developed from this data. A 5 minute interval unit graph was developed for this watershed, which resulted in a peak inflow of 1916 c.f.s. and a time to peak of 14 minutes. Application of the probable maximum precipitation minus losses results in a flood hydrograph peak inflow of 6316 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

Based on our analyses, the combined spillways will pass 22 percent of the Probable Maximum Flood (PMF). The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that the structure (small size with high downstream hazard potential) pass 50 to 100 percent of the PMF, without overtopping. Considering that the maximum storage capacity is only 92 ac.-ft and that the height of the dam is only 27.7 ft, 50 percent of the PMF has been determined to be appropriate spillway design flood.

The routing of 50 percent of the PMF through the spillway and dam indicates that the dam will be overtopped by 0.89 ft at elevation 102.29. The duration of the overtopping will be 0.67 hours, and the maximum outflow will be 2979 c.f.s. The maximum discharge capacity of the combined spillways is 1154 c.f.s. Analysis of the data indicates that the 100-year frequency flood will not overtop the dam.

OVERTOPPING ANALYSIS FOR G. GUNDAKER DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.
Hydraulic Inputs Are As Follows:
 - a. Twenty-four Hour Rainfall of 25.3 Inches For 200 Square Miles - All Season Envelope
 - b. Drainage Area = 358 Acres; = 0.56 Sq. Miles
 - c. Travel Time of Runoff 0.33 Hrs.; Lag Time 0.20 Hrs.
 - d. Soil Conservation Service Soil Group C
 - e. Soil Conservation Service Runoff Curve No. 87 (AMC III)
 - f. Proportion of Drainage Basin Impervious .05
2. Spillways
 - a. Primary Spillway: Concrete V Shaped Weir, 1'
Wide At Crest El. 97.7 C = 3.0 Rating Curve Equation $(Q=CLH^{3/2})$
 - b. Emergency Spillway
Length 50 Ft.; Side Slopes 50-100:1 ; C = 3.0
 - c. Dam Overflow
Length 970 Ft.; Crest El. 101.4 ; C = 3.0
3. Spillway and Dam Rating:

Curve Prepared by Hanson Engineers. Data Provided To Computer on Y4 and Y5 Cards.

Note: Time of Concentration From Equation $T_c = \left(\frac{11.9 L^3}{H} \right)^{.385}$
California Culvert Practice, California Highways and Public Works, Sept. 1942.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph
 - a. Peak - 1916 c.f.s.
 - b. Time to Peak 14 Min.
2. Flood Routings Were Computed by the Modified Puls Method
 - a. Peak Inflow
50% PMF 3158 c.f.s.; 100% PMF 6316 c.f.s.
 - b. Peak Elevation
50% PMF 102.29 100% PMF 103.03
 - c. Portion of PMF That Will Reach Top of Dam
22 %; Top of Dam Elev. 101.4 Ft.
3. Computer Input and Output Data are shown on Sheets 5 and 6 of this Appendix. The flood hydrographs for 50 percent of the PMF are presented on Sheet 7.

A OVERTOPPING ANALYSIS FOR DAM #24
A CO CODE 071 FRANKLIN CO MO. #30543 OWNER GORDON GUNDAKER
A HANSON ENGINEERS INC DAM SAFETY INSPECTION JOB #79511

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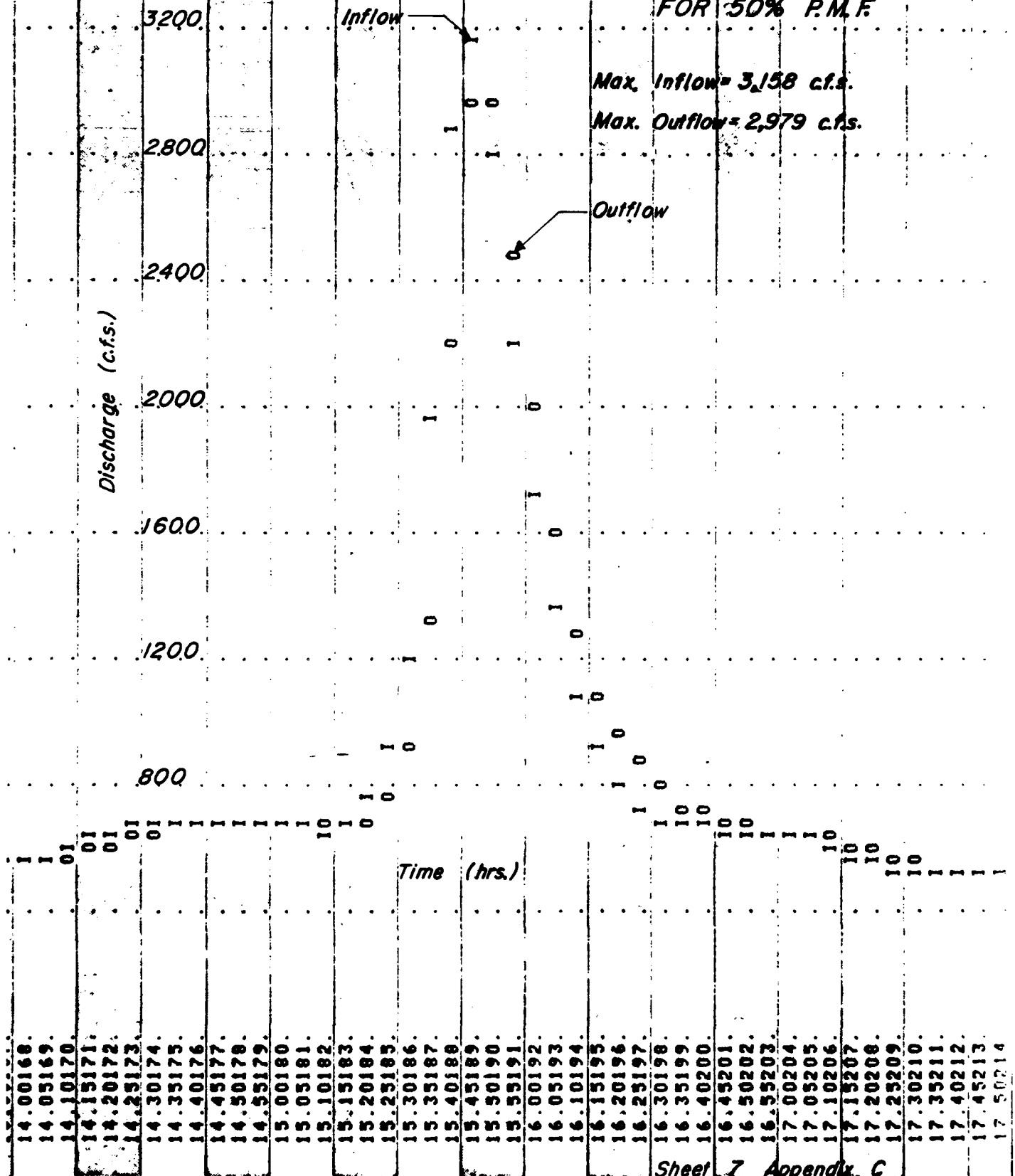
PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS				
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				0.20	0.30	0.40	0.50	1.00
HYDROGRAPH AT	1	0.56	1	1263.	1895.	2527.	3158.	6316.
	(	1.45)	(	35.77)	53.66)	71.54)	89.43)	178.86)
ROUTED TO	2	0.56	1	1074.	1763.	2382.	2979.	6151.
	(	1.45)	(	30.40)	49.94)	67.46)	84.36)	174.17)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1			INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
ELEVATION								
STORAGE			97.69		97.70		101.40	
OUTFLOW			61.		61.		92.	
			0.		0.		1154.	
RATIO OF PHF	MAXIMUM RESERVOIR U.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS	
0.20	101.31	0.00	92.	1074.	0.00	15.83	0.00	
0.30	101.74	0.34	95.	1763.	0.33	15.83	0.00	
0.40	102.06	0.66	98.	2382.	0.50	15.83	0.00	
0.50	102.29	0.89	100.	2979.	0.67	15.75	0.00	
1.00	103.03	1.63	107.	6151.	3.08	15.75	0.00	

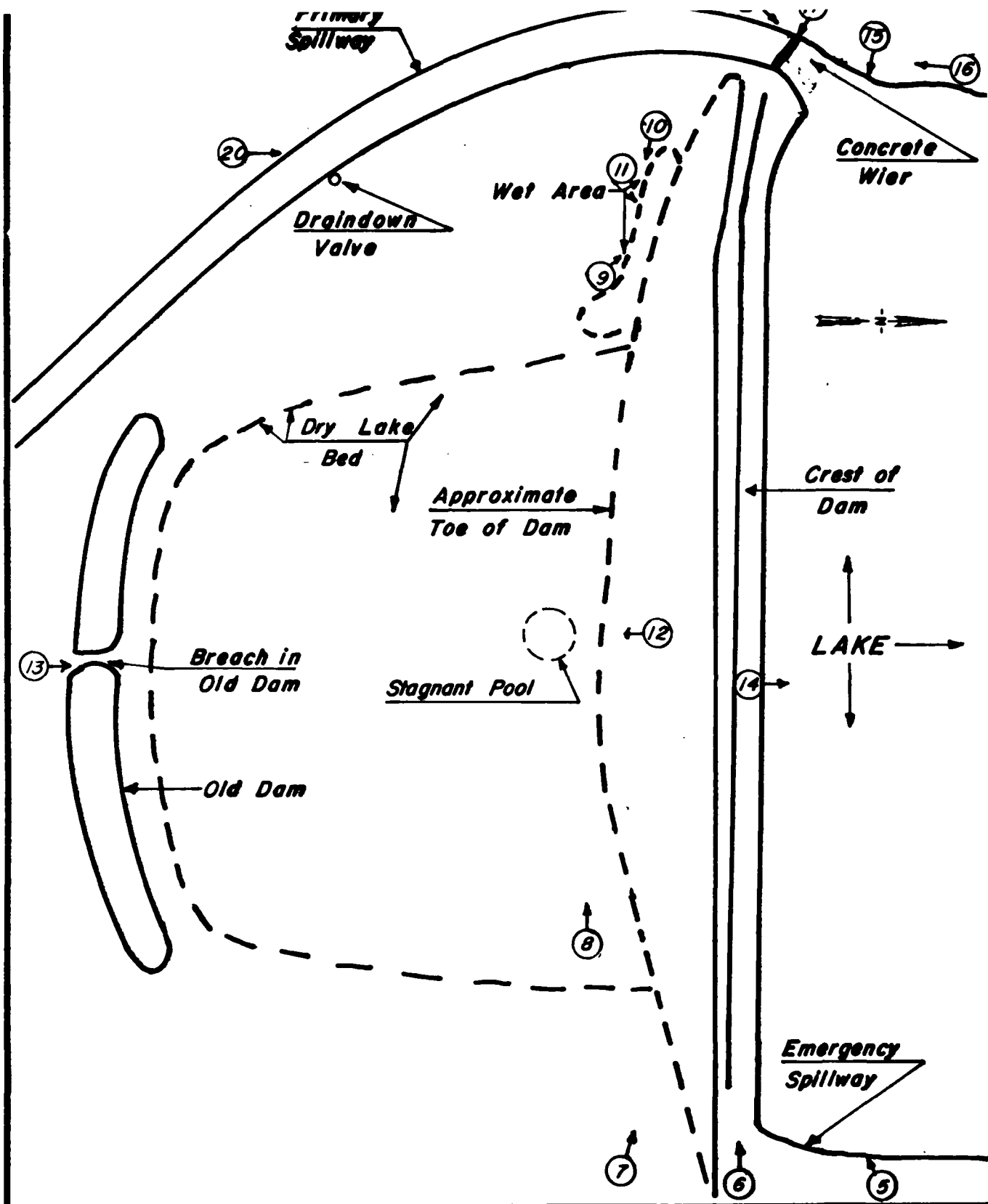
INFLOW - OUTFLOW HYDROGRAPH FOR 50% P.M.F.



APPENDIX D

LIST OF PHOTOGRAPHS

<u>Photo No.</u>	<u>Description</u>
1.	Aerial - Looking Southwest at Lake and Watershed
2.	Aerial - Looking West at Dam and Lake
3.	Aerial - Looking Northwest at Dam and Lake
4.	Aerial - Looking Northeast - Spillway in Foreground
5.	Upstream Face of Dam - Looking Southwest
6.	Crest of Dam - Looking West
7.	Downstream Face From East Abutment
8.	Downstream Toe of Dam - Looking West
9.	Apparent Seepage Area At West Abutment
10.	Seepage at West Abutment Looking Downstream
11.	Seepage at West Abutment
12.	Pool at Downstream Toe Looking Toward Breach in Old Dam
13.	Downstream Face of Main Dam Looking Through Breach in Old Dam
14.	Lake - Looking From Crest, Note Island
15.	Upstream Face Looking Northeast - Spillway on Right
16.	Spillway Approach - Looking Downstream
17.	Spillway - Control Section on Left
18.	Spillway Control - Looking Upstream
19.	Spillway - Looking Downstream
20.	Valve and Outlet for Drawdown Pipe



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 DATE 6-18-79
 JOB NO. 79511

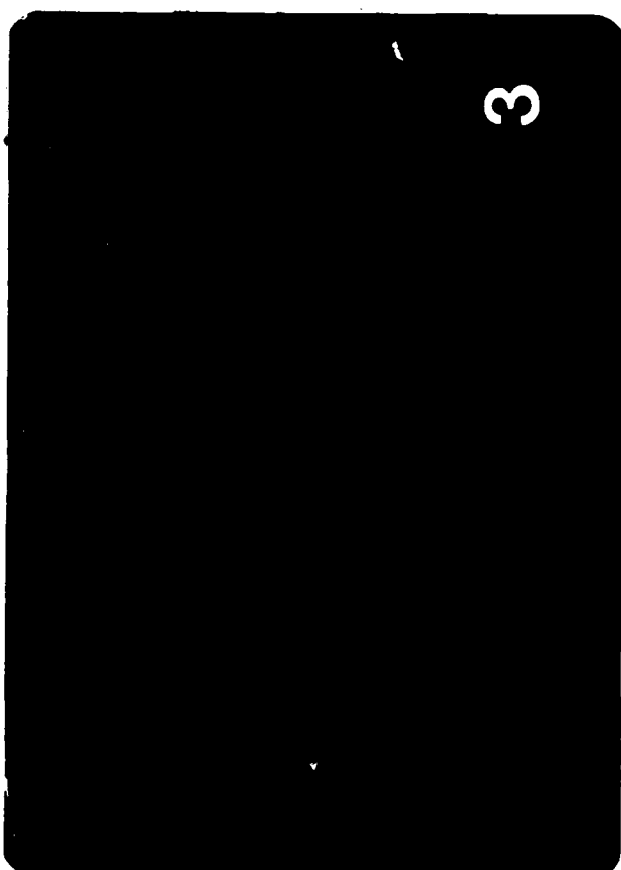
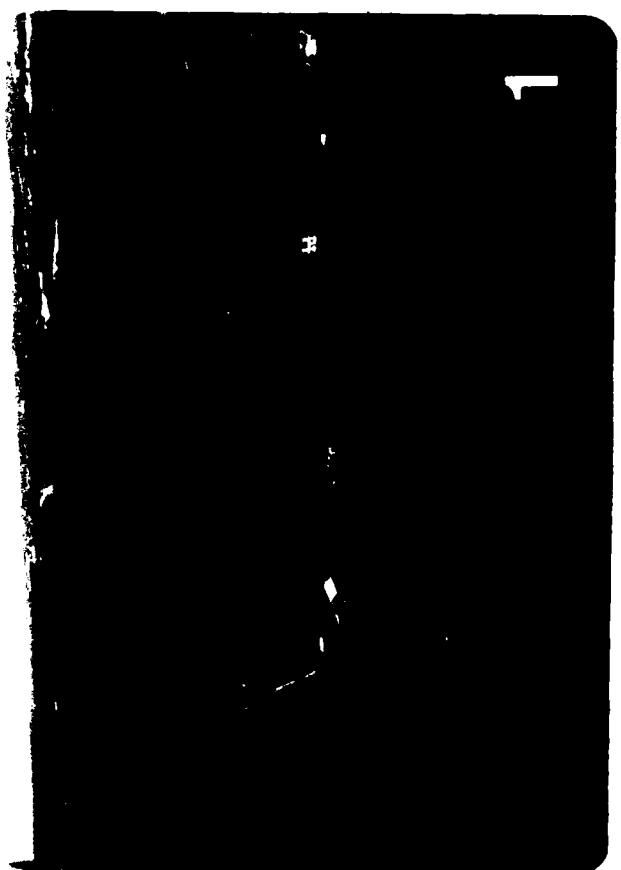
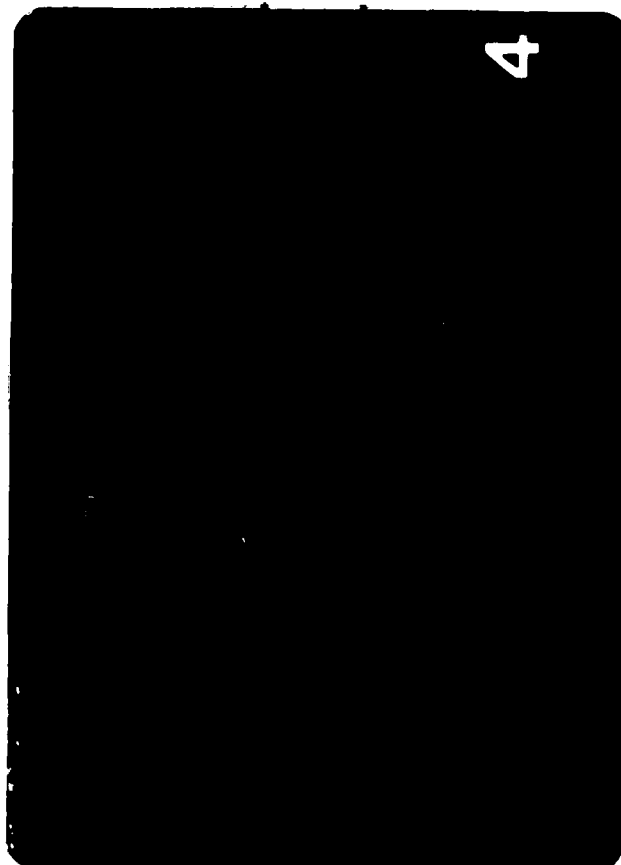


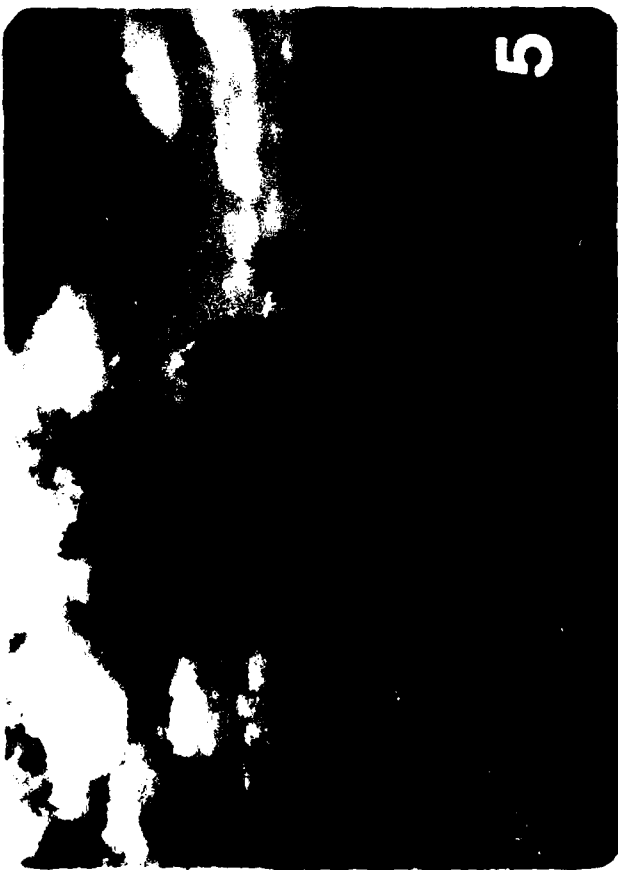
HANSON
 ENGINEERS

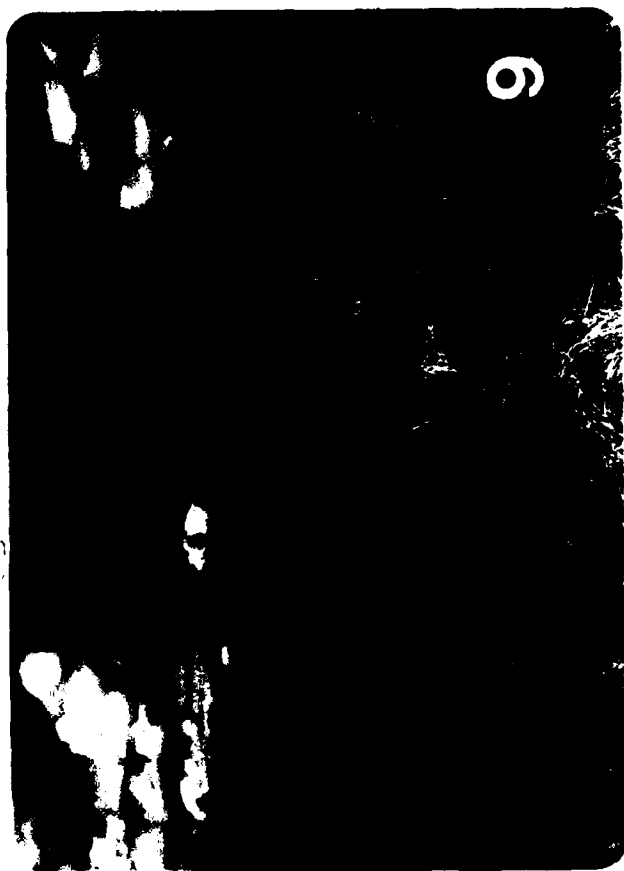
SPRINGFIELD ILL.

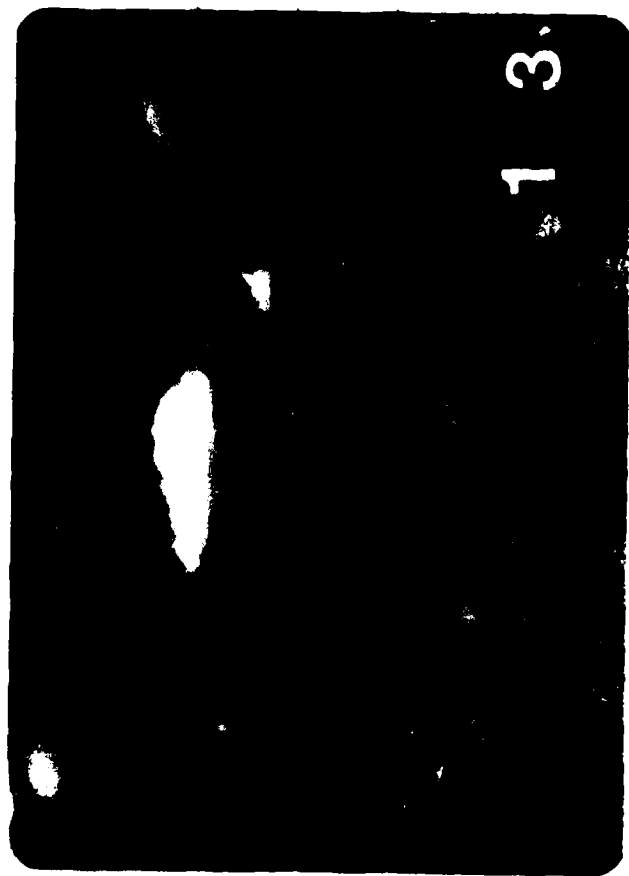
PEORIA ILL.

Plan Sketch
 Key To Photographs
 Sheet 2 Appendix D

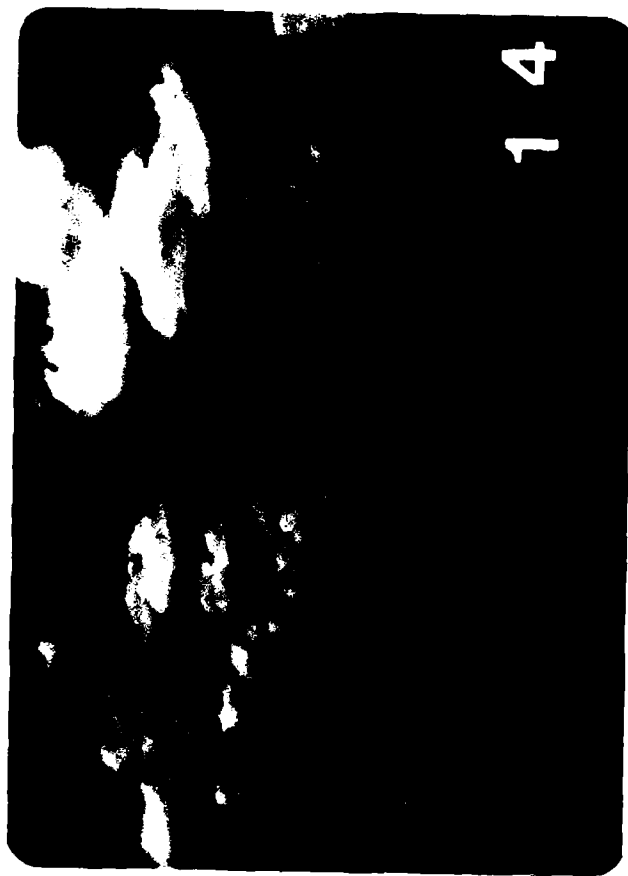








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15



16



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